Final Technology Evaluation Report
Volume II

Physical Separation and Acid Leaching: A Demonstration of Small-Arms Range Remediation at Fort Polk, Louisiana

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and

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by

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APPENDIX A
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APPENDIX B
Data Archiving and Demonstration Plan

Raw data from the demonstration have been archived at the NFESC in hard copy and electronic format. The approved demonstration plan has also been archived at the NFESC. To obtain copies of either the data or the plan, contact Barbara Nelson at the NFESC (see Appendix A).

APPENDIX C

SITE CHARACTERIZATION DATA

APPENDIX D
Bench-Scale Tests

Acetic Acid Bench-Scale Tests

ContraCon Northwest conducted a series of three bench-scale test programs over the period June 23 through August 7, 1996. The first two test programs produced érratic results due to problems with laboratory technique for removal of the particulate lead, but the third program indicated a reduction in total lead concentration to 410 mg/kg overall with a TCLP lead concentration of 12 mg/L. The basic bench-scale program was developed to simulate the performance of the full-scale system as shown in Table D-1.

Table D-1. Comparison of Bench-Scale and Full-Scale Process Steps for Vendor 1 (Acetic Acid Process)

Bench-Scale Procedure	Related Full-Scale Function
Attrition scrubbing (hand-held power mixer)	Attrition scrubbing (blade mill)
Physical separation (wet screening)	Physical separation (vibrating sieve, blade mill, hydrocyclones, sandscrew)
Removal of particulate lead (panning)	Removal of particulate lead (jigs)
Acid leaching and attrition scrubbing of sands (beakers)	Acid leaching and attrition scrubbing of sands (blade mill, sand screw)
Acid leaching of fines (beakers)	Acid leaching of fines (leaching tanks)
Flocculation of suspended particles (beaker)	Flocculation of suspended particles (leaching tanks)
Dewatering of fines (centrifuge)	Dewatering of fines (vacuum belt filter)
Precipitation of lead (beaker)	Precipitation of lead (precipitation tank)

Approximately 10 gal of soil was provided by BDM to ContraCon Northwest for the bench-scale tests. Table D-2 presents the distribution of lead, copper, zinc, and antimony in various size fractions as obtained by wet sieving.

For each of the test programs, a 2,000- to 5,000-g sample was placed in a 5-gal container to which was added 4 to 6 L of acetic acid solution at pH 3.5. The mixture was mechanically agitated in the container for about 40 minutes. After this "attrition scrubbing" was completed, the acid solution was decanted and the soil wet screened through a sieve stack (1/2-inch, 3/8-inch, ¼-inch, 20-mesh, 100-mesh, and 200-mesh) using fresh acetic acid solution at pH 3.5. The soil fractions were then panned to remove particulate lead.

APPENDIX E
Comparison of Alternative Technologies

This appendix presents alternative technologies in addition to the physical separation and acid leaching technologies demonstrated at Fort Polk and the alternative technologies mentioned in Section 8.0. The comparison follows the same two-stage screening approach applied in Section 8.0. A variety of reference documents are available if more detailed technology performance and selection data are required (Conner, 1990; U.S. EPA, 1992, EPA/540/2-91/014; U.S. EPA, 1992, EPA/540/S-92/011; U.S. EPA, 1995, EPA/540/R-95/512)

E.1 Technology Review and Prescreening

This section provides overviews of a broad range of technologies that can be applied to remediate metal contamination in small-arms range soils.

E.1.1 On-Site Asphalt Encapsulation

Contaminated small-arms range soils can be used as part of the fine aggregate in asphaltic concrete. The recycling of wastes as aggregate in asphaltic concrete is not a particularly new concept. A wide variety of industrial solid wastes have been successfully substituted for some portion of asphalt graded aggregate without adverse effects on product quality. Using oil contaminated soil as asphalt aggregate in construction projects has been practiced for many years (U.S. EPA, 1992, EPA/600/R-92/096). Recycling of RCRA hazardous waste as asphalt aggregate will encounter greater regulatory hurdles.

The recycling technology involves substituting the waste for a portion of the fine-size aggregate in asphaltic concrete. Typically, asphaltic concrete consists of 4.5 to 8% bitumen mixed with graded aggregate. The aggregate is made by mixing rock and sand to give particles ranging from fine sand to 2- to 1-in. (13 mm to 25 mm) gravel. Depending on the mix design and the ultimate strength requirements of the product, the fine-size particle fraction may comprise 35 to 45% of the asphaltic concrete. As long as the metal concentrations in the waste are low, the metal concentrations in the asphaltic concrete product will be low, and any metals present will be physically and chemically immobilized in the bitumen binder.

The asphalt recycling approach is viable for only certain types of aggregates. The aggregate must comply with both performance and environmental standards such as durability, stability, chemical resistance, biological resistance, permeability, and leachability (Testa and Patton, 1994). A sharp, angular particle shape is preferred for asphaltic concrete aggregate. The principal limitations pertain to risk, regulatory considerations, or technical considerations pertaining to the integrity of the asphaltic concrete product.

Some asphalt paving companies accept nonhazardous waste that is delivered to their plant and that has desirable properties without charging a tolling fee. These direct aggregate replacement wastes can be recycled for the cost of excavation, screening, and hauling. Small-arms range soils would typically exhibit a hazardous waste characteristic and would not be accepted for general

Appendix F
Vendor 1 (Acetic Acid) Data

Appendix G
Vendor 2 (Hydrochloric Acid) Data

APPENDIX H
XRF Data

APPENDIX I

Cost Data

The cost data generated for the acetic acid and hydrochloric acid demonstrations given in Tables 7-12, 7-13, 7-14, and 8-1 were obtained from information provided by the site support contractor, the individual vendor reports submitted, and the sampling and analytical costs incurred by Battelle. In addition, Battelle received residuals disposal cost reports from the second vendor and the disposal facility used by the first vendor.